OH4270_S191

Final
Remedial Actions
Quarterly Report
Report Period:
October 1997 - December 1997

McCormick & Baxter Creosoting Company
Portland Plant

Task Order No. 88-97-5

May 1998

Prepared for:

STATE OF OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
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1 Introduction and Summary

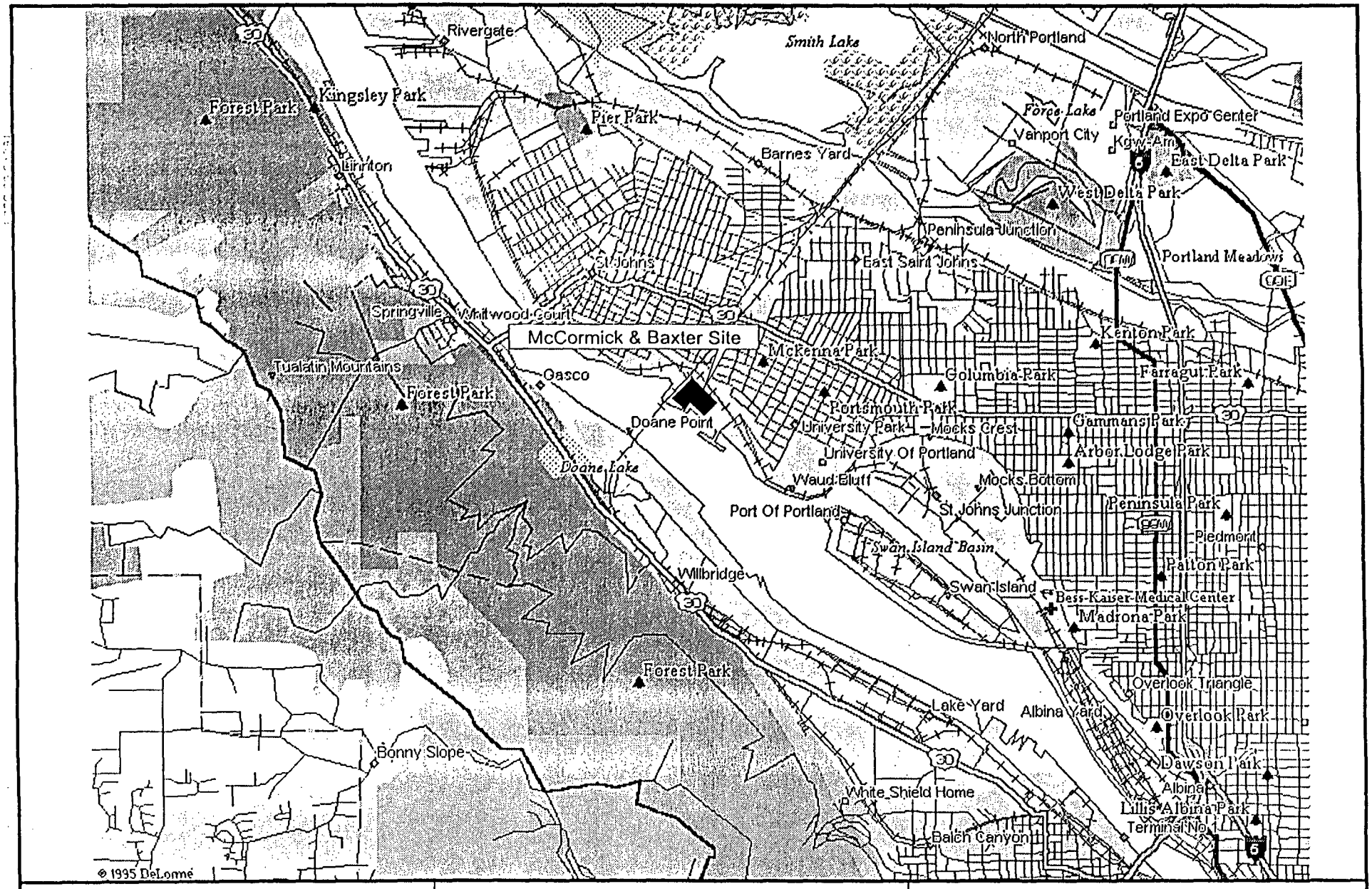
1.1 Introduction

Ecology and Environment, Inc. (E & E), under contract with the Oregon Department of Environmental Quality (DEQ), has prepared this Remedial Actions Quarterly Report for the McCormick & Baxter Creosoting Company, Portland Plant site (McCormick & Baxter) located in Portland, Oregon (see Figure 1-1). This report covers the period from October 1, 1997 to December 31, 1997. The site, a former wood-treating facility, is located along the Willamette River at 6900 North Edgewater Street (see Figure 1-2). This document has been prepared under Task Order Number 88-97-5. The purpose of the task order is to assist DEQ with implementation of remedial actions, wastewater treatment plant operations and maintenance (O & M), and remedial design/remedial action activities at the site.

This Remedial Actions Quarterly Report describes the non-aqueous phase liquid (NAPL) monitoring and extraction activities (Section 2), water treatment system operations (Section 3), quarterly groundwater monitoring (Section 4), general site operation tasks (Section 5), and recommendations and conclusions (Section 6). Appendix A contains documentation of transducer data generated during this period.

1.2 Quarterly Summary

Table 1-1 provides a monthly summary of activities conducted by E & E.



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Seattle, Washington

McCORMICK & BAXTER CREOSOTING CO.
PORTLAND, OREGON

FIGURE 1-1

SITE LOCATION MAP

0 .5mi 1 mile
Approximate Miles

Drawn By:	Date	TDD/Job No.	Dwg. No.
MRE	10-11-96	OH4270	4270F1

N

North Edgewater Street

Site Entrance

GATE

Parking Lot

OVERFLOW TANK

Union Pacific Railroad

Office

Paint Shed

Site Boundary

Central Process Area

Storage Tanks

Pilot Water Treatment System

Lab

Retort 3

Retort 2

Retort 1

Former Tank Farm

PCP Hopper

Butt Tank 1

Southeast Former Waste Disposal Trench

ACC Soils

GATE

Cellon Wash Area

Boiler room

Butt Tank 2

Wigwam Burner

Tank Farm Area (TFA)

Settlers and Evaporator

Framing Shed

Total Fulids Storage Tank

PCP Mixing Shed

Retort 4

PCP Crystals

Buried Naphthalene Blocks

Former Creosote Tank 4

Pole Peeler

Burlington Northern Railroad

PCP Soils

Former Waste Disposal Pond

Former Waste Disposal Area (FWDA)

Hazardous Waste Storage Area

Rail Spurs

NAPL STORAGE TANK

FWDA TREATMENT SYSTEM

Sewer line

Creosote Dock

OUTFALL 001 (Former cooling water)

OUTFALL 002 (Stormwater; treated water from pilot treatment system)

OUTFALL 003 (Stormwater)

OUTFALL 004 (Stormwater)

OUTFALL 005 (treated water from FWDA treatment system)

100 80 60 40 30 20 10

LEGEND

- Site boundary or shoreline
- Paved area
- Existing structure
- Former structure (See Note)
- Outfall
- Soil removal areas (1994)
- Fence

NOTE:

THE OFFICE BUILDING, LABORATORY, AND WATER TREATMENT PLANT (FORMER SHOP BUILDING) REMAIN AT THE SITE. ALL OTHER ABOVE-GROUND STRUCTURES AND OBJECTS WERE REMOVED DURING PHASE I DEMOLITION IN MAY, 1997.

SCALE IN FEET (GRAPHIC SCALE)

0 200 400 600

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DESIGNED BY: C. NANCARROW

CHECKED BY: K. SMITH

DRAWN BY: E.MARTIN

APPROVED BY: XXXXXXX

FIGURE 1-2

PROPERTY FEATURES

McCORMICK & BAXTER CREOSOTING CO.
PORTLAND, OREGON

SCALE	DATE ISSUED	CAD FILE NO.	DRAWING NO.
NOTED	2-18-98	PROP_FEA.DWG	X OF X

TABLE 1-1

SUMMARY OF QUARTERLY ACTIVITIES
OCTOBER 1997 - DECEMBER 1997
McCORMICK AND BAXTER SITE
PORTLAND, OREGON

MONTH	ACTIVITY	STATUS
October 1997	Pure-phase manual NAPL extraction on 10/9, 10/16, 10/23, and 10/31.	Complete
	NAPL measurements recorded on 10/9, 10/16, 10/23, and 10/31.	Complete
	Quarterly groundwater sampling performed week of 10/27.	Complete
	Groundwater elevations measured on 10/9, 10/16, 10/23, and 10/31.	Complete
	Prepared a hole in the perimeter fence on 10/15.	Complete
	Prepared a hole in the fence near the FWDA on 10/23.	Complete
	Meter check performed by PGE on 10/24.	Complete
	Surveying of supplemental soil sampling locations during week of 10/27.	Complete
November 1997	Pure-phase manual NAPL extraction on 11/7, 11/14, 11/20, and 11/26.	Complete
	NAPL measurements recorded on 11/7, 11/14, 11/20, and 11/25.	Complete
	Groundwater elevations measured on 11/7, 11/14, 11/21, and 11/25.	Complete
	Forklift serviced by Premier on 11/7. During repair, a lender forklift was used.	Complete
	Winterized dust suppression system on 11/12.	Complete
	Repaired break in fence near FWDA on 11/17.	Complete
	Attorneys for McCormick and Baxter Creosoting Co., their insurance group, and Burlington Northern R.R. were on-site looking through papers in the office building.	Unknown
December 1997	Pure-phase manual NAPL extraction on 12/5, 12/12, 12/18, and 12/24.	Complete
	NAPL measurements recorded on 12/1, 12/8, 12/16, 12/22, and 12/30.	Complete
	Groundwater elevations measured on 12/1, 12/8, 12/16, 12/22, and 12/30.	Complete
	Attorneys were on-site looking through papers in the office building.	Unknown
	New heater installed in caustic soda container for the DAF unit on 12/17.	Complete
	Ion exchange unit for FWDA treatment system ordered from ATA.	Complete
	Bladder valve to DAF unit malfunction on 12/24. New part in on 12/31. Installation scheduled for 1/2/98.	Incomplete
	Repaired hole in perimeter fence on 12/30.	Complete

2 NAPL Extraction Site Operations

NAPL Distribution

Releases of NAPL contaminants from the main source areas at the site, in particular the Tank Farm Area (TFA) and the Former Waste Disposal Area (FWDA), primarily have affected the shallow aquifer. Creosote and other organic compounds are found as both light nonaqueous-phase liquids (LNAPLs) and dense nonaqueous-phase liquids (DNAPLs) in soil and groundwater adjacent to the Willamette River. As the pure-phase NAPL has migrated toward the river, it has also spread downward vertically, affecting a thick section of sands adjacent to the river. Two distinct NAPL plumes are present at the site: one in the TFA, the other in the FWDA. Smaller NAPL plumes are present near monitoring well MW-1 and the former location of Butt Tank #1 in the northeast portion of the site.

2.1 NAPL Measurements

The thickness of NAPL is measured in wells in the TFA and FWDA on a weekly basis and prior to manual NAPL extraction activities. The thickness of LNAPL and DNAPL varies on a daily basis due to a number of conditions including groundwater elevation, river stage fluctuations, and pumping frequency. Tables 2-1 and 2-2 present the historical thicknesses of LNAPL and DNAPL, respectively, in the source areas and the maximum thicknesses measured in the monitoring wells for the quarter. Well locations with associated NAPL classifications are presented in Table 2-3 and on Figure 2-1. NAPL measurements were recorded in October, November, and December 1997. Four monitoring wells (EW-12s, EW-17s, MW-20i, and MW-Ds) contained LNAPL that exceeded the historic maximum measurements, and one monitoring well (EW-14s) contained DNAPL that exceeded the historic maximum measurements during this quarter.

As noted in Table 2-3, the NAPL classifications in a significant number of wells changed during this quarter. In the TFA, five wells (MW-10s, EW-4s, EW-7s, EW-17s, and EW-18s) which historically contained both LNAPL and DNAPL, contained only LNAPL during this quarter. In the FWDA, eleven wells had changes in the type of NAPL detected during the quarter. Five of the wells (EW-2s, EW-13s, EW-19s, EW-20s, and MW-18s) contained NAPL during the previous quarter, however, no NAPL was detected during this quarter.

Table 2-1

HISTORICAL AND MONTHLY LNAPL THICKNESS
OCTOBER 1, 1997 TO DECEMBER 31, 1997
MCCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

Well ID	Maximum LNAPL Thickness (ft)	Date	October 1997 LNAPL Thickness (ft)	November 1997 LNAPL Thickness (ft)	December 1997 LNAPL Thickness (ft)
Tank Farm Area					
EW-1s	1.3	?	NA	0.20	0.02
EW-4s	1.5	Sep-92	NA	0.02	0.02
EW-5s	0.9	Sep-94	0.02	ND	0.02
EW-7s	1.4	Sep-92	ND	0.12	ND
EW-12s	0.30	Nov-97	ND	0.30	0.01
EW-17s	1.49	Nov-97	0.23	1.49	0.68
EW-18s	4.43	Jul-94	0.22	0.08	0.38
MW-Is	1.7	?	NA	0.06	0.02
MW-Rs	3.1	Mar-96	1.20	1.92	1.12
MW-7s	2.76	Sep-92	ND	ND	ND
MW-10s	8.08	Feb-93	NA	0.41	0.38
Former Waste Disposal Area					
EW-3s	0.87	Aug-96	ND	0.21	0.25
EW-6s	3.5	Aug-94	0.03	0.03	0.02
EW-9s	0.02	Sep-97	ND	0.02	0.01
EW-10s	7.5	Jul-93	0.36	3.49	3.40
EW-14s	1.31	Mar-95	0.06	ND	0.02
EW-15s	10.02	Aug-97	2.15	2.66	2.89
EW-20s	1.11	May-96	ND	ND	ND
MW-20i	0.04	Nov-97	ND	0.04	0.01
MW-18s	0.14	Sep-94	ND	ND	ND
MW-21s	10.28	Sep-92	0.20	2.16	0.23
MW-Es	2.97	Sep-92	NA	NA	NA
MW-Ds	0.01	Nov-97	ND	0.01	0.01
MW-Gs	2.34	Sep-92	NA	0.05	0.01
Other					
MW-1s	?	?	1.71	0.52	0.48

Only wells with any LNAPL detected are presented in this table.

Key:
? = Unknown
NA = LNAPL present, but at insufficient quantity for accurate measurement.
ND = LNAPL measured, but not detected.
NM = Not measured.
[shaded] = Maximum measurement.

Table 2-2

HISTORICAL AND MONTHLY DNAPL THICKNESS
OCTOBER 1, 1997 TO DECEMBER 31, 1997
MCCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

Well ID	Maximum DNAPL Thickness (ft)	Date	October 1997 DNAPL Thickness (ft)	November 1997 DNAPL Thickness (ft)	December 1997 DNAPL Thickness (ft)
Tank Farm Area					
EW-1s	4.7	Oct-94	0.10	2.79	0.51
EW-4s	6.2	Mar-93	ND	ND	ND
EW-5s	2.92	Dec-95	0.13	0.45	0.56
EW-7s	2.09	Dec-94	ND	ND	ND
EW-8s	2.7	Jul-93	0.55	2.50	1.99
EW-17s	1.27	Aug-96	ND	ND	ND
EW-18s	1.02	Dec-95	ND	ND	ND
MW-10s	0.32	May-97	ND	ND	ND
MW-Is	9.93	Aug-87	2.78	2.68	5.99
MW-7s	3.67	Nov-91	2.40	3.28	3.67
MW-8i	3.62	Mar-96	3.60	0.90	1.24
EW-12s	1.15	Jan-96	0.25	0.30	1.13
MW-22i	3.02	Oct-94	ND	ND	1.66
MW-Ni	NA	NA	ND	ND	ND
Former Waste Disposal Area					
EW-2s	1.9	Aug-91	ND	ND	ND
EW-6s	3.4	Aug-93	2.45	2.20	2.17
EW-9s	3.16	Jan-96	0.19	ND	ND
EW-10s	1.36	Aug-97	ND	ND	ND
EW-14s	1.9	Dec-97	ND	ND	1.90
EW-15s	0.16	May-97	ND	ND	ND
MW-20i	34.32	Dec-94	14.60	31.70	14.80
MW-21s	0.94	May-97	ND	0.47	0.29
MW-Ds	6.01	Jan-94	3.81	1.67	1.83
MW-Es	4.2	Aug-87	ND	0.42	0.91
MW-Gs	14.85	Mar-91	4.60	9.11	5.17
Southeast Disposal Trench Area					
EW-11s	NA	NA	ND	ND	ND
MW-18s	NA	NA	ND	ND	ND
MW-19s	2.01	Jul-91	0.47	0.33	0.47

Only wells with any DNAPL detected are presented in this table.

Key:
? = Unknown
NA = DNAPL present, but at insufficient quantity for accurate measurement.
ND = DNAPL measured, but not detected.
NM = Not measured.
= Maximum measurement.

TABLE 2-3

NAPL WELL CLASSIFICATIONS
4th QUARTER 1997

MCCORMICK AND BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

Well Identification	3rd Quarter 1997	4th Quarter 1997
Tank Farm Area		
MW-7s	◒	◒
MW-8i	◒	◒
MW-10s	●	◒
MW-22i	◒	◒
MW-Is	●	●
MW-LRs	⊕	⊕
MW-Ps	⊕	⊕
MW-Rs	◒	◒
EW-1s	●	●
EW-4s	●	◒
EW-5s	●	●
EW-7s	●	◒
EW-8s	◒	◒
EW-12s	●	●
EW-17s	●	◒
EW-18s	●	◒

TABLE 2-3

NAPL WELL CLASSIFICATIONS
4th QUARTER 1997

MCCORMICK AND BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

Well Identification	3rd Quarter 1997	4th Quarter 1997
Former Waste Disposal Area		
EW-2s	⊕	⊕
EW-3s	⊕	⊕
EW-6s	●	●
EW-9s	⊕	●
EW-10s	●	⊕
EW-13s	⊕	⊕
EW-14s	⊕	●
EW-15s	●	⊕
EW-19s	⊕	⊕
EW-20s	⊕	⊕
MW-18s	⊕	⊕
MW-20i	⊕	●
MW-21s	●	●
MW-Ds	⊕	●
MW-Es	●	●
MW-Gs	●	●

TABLE 2-3

NAPL WELL CLASSIFICATIONS
4th QUARTER 1997

MCCORMICK AND BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

Well Identification	3rd Quarter 1997	4th Quarter 1997
Other Areas:		
MW-1s	◓	◓
EW-11s	◒	◒
MW-19s	◒	◒

Key:

◓ = Presence of LNAPL during quarter.

◒ = Presence of DNAPL during quarter.

● = Presence of both LNAPL and DNAPL during quarter.

⊕ = No presence of NAPL during quarter.

2.2 NAPL Extraction

NAPL extraction activities performed during this operation period include pure-phase NAPL extraction and enhanced NAPL extraction.

Pure-phase NAPL collection entails extraction of quantifiable NAPL volumes from select wells with minimal water extraction and processing. Pure-phase extraction activities include manual NAPL extraction, FWDA continuous NAPL extraction, and passive skimmer LNAPL removal.

Enhanced NAPL extraction is conducted in the TFA at select wells. Both NAPL and water are extracted, conveyed, then subsequently treated in the Pilot Water Treatment System. The system utilizes dissolved air flotation (DAF) to remove the NAPL from the waterstream and produces a sludge that is removed from the system and stored in the sludge tank. The sludge is composed of NAPL, water, and chemicals used in the DAF process. As such, quantification of pure-phase NAPL removed by this system is not possible.

2.2.1 Pure-Phase NAPL Extraction

2.2.1.1 Manual NAPL Extraction

Manual NAPL extraction was conducted throughout this operation period. The extraction process requires extensive manual labor to measure the NAPL wells for the presence of pure-phase product; set up the extraction pump; operate the pump to ensure minimal water extraction; and clean the oil/water interface probe, pump, and product hoses and carry the product to the Sludge Tank. Pure-phase NAPL extraction is considered a weekly activity. Table 2-4 contains a summary of the NAPL manually extracted during this period. Determining total NAPL volume removed is still an estimation process, and exact NAPL volumes are not known. However, the volumes listed in Table 2-4 represent visual estimates and calculations of NAPL and/or highly contaminated groundwater.

In the TFA, EW-8s was the most productive NAPL well with a total estimated volume of 11.6 gallons removed by manual extraction. In the FWDA, EW-10s was the most productive NAPL well with 13.4 gallons of NAPL removed by manual NAPL extraction.

2.2.1.2 FWDA Continuous NAPL Extraction

During the fourth quarter of 1997, up-welling tests were conducted at wells EW-9s, MW-Gs, and MW-Ds in the FWDA to determine the potential effects of groundwater extraction above the NAPL/water interface. The results of the testing are presented in Section 2.3.

Table 2-4

PURE-PHASE NAPL EXTRACTION SUMMARY
OCTOBER 1 TO DECEMBER 31, 1997
MCCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON
(units: gallons)

	NAPL Extracted for Quarter
TFA Well (manual)	
MW-7s	9.88
MW-8i	6.08
MW-22i	3.0
MW-Is	8.64
EW-1s	5.6
EW-8s	11.6
EW-17s	1.6
MW-Rs	3.76
Total:	**50.16**
FWDA Well (manual)	
EW-14s	2.6
EW-6s	12.8
EW-10s	13.4
MW-17s	1.0
MW-21s	1.8
Total:	**31.6**
Passive LNAPL Skimmers	
MW-1s	1.8
EW-15s	2.25
Total:	**4.05**
FWDA Treatment System (continuous)	
LNAPL (storage drum)	0.6
DNAPL (storage tank)	53
Total:	**53.6**
GRAND TOTAL:	**139.41**

Continuous NAPL extraction was performed on monitoring well MW-20i during the fourth quarter. The pump is installed in the bottom of the well for DNAPL extraction only.

The NAPL and water from each extraction well is pumped to the FWDA treatment system, where the NAPL is separated via oil/water separation. DNAPL is collected in a storage tank and minimal quantities of LNAPL are removed and contained in a storage drum. During the 4th quarter 1997, approximately 53 gallons of DNAPL and 0.6 gallons of LNAPL were removed.

2.2.1.3 Passive Skimmer LNAPL Removal

The passive LNAPL skimmers installed in wells EW-15s and MW-1s were emptied approximately once per week during the quarter. Approximately 1.8 gallons of LNAPL from MW-1s and 2.25 gallons from EW-15s were removed during this quarter.

2.2.1.4 Pure-Phase NAPL Extraction Summary

A total of approximately 139.41 gallons of pure-phase NAPL was removed through various NAPL extraction techniques during in this quarter (see Table 2-4). The total pure-phase extracted NAPL documented from December 1995 through this quarter is graphically presented in Figure 2-2.

2.2.2 Enhanced NAPL Extraction

Enhanced NAPL extraction was conducted throughout the operation period at wells EW-1, EW-4, and EW-7 in the TFA. The operation summary for each well is shown in Table 2-5. An estimated total of 231,846 gallons of water/NAPL were extracted and conveyed to the Pilot Water Treatment System this period. The treatment system operation summary is discussed in Section 3 of this report.

2.2.3 Extraction Operation Modifications

No modification of the operation parameters were made this quarter.

2.2.4 Problems and Corrective Actions

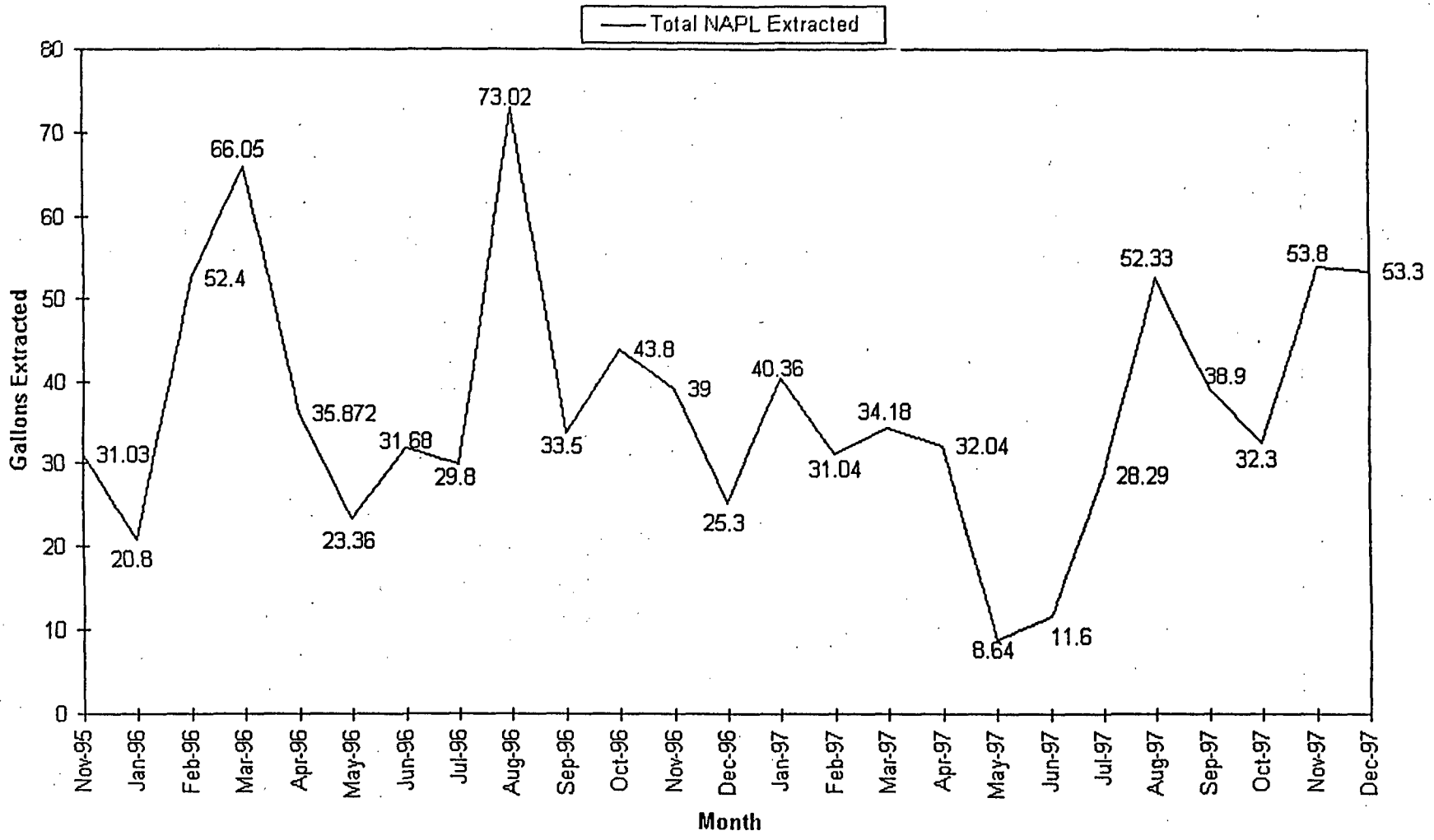
Collection of NAPL measurements from wells continues to be a problem. Gauging of the water/NAPL interface in two-inch diameter wells equipped with pumps is difficult. Modifications to the NAPL extraction system are currently being evaluated that may alleviate some of the existing problems with NAPL measurements. It is anticipated that these

Table 2-5

TFA ENHANCED NAPL EXTRACTION WELL OPERATION SUMMARY
OCTOBER 1, 1997 TO DECEMBER 31, 1997
MCCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON
(units: as noted)

WELL NUMBER	TOTAL OPERATION TIME (HR:MN:SS)	WATER EXTRACTION RATE (gpm)	TOTAL VOLUME OF WATER EXTRACTED* (gallons)
EW-1	399:30:00	2.3	55,775
EW-4	399:30:00	3.7	88,501
EW-7	399:30:00	3.7	87,570
TOTAL			231,846

* = Volume estimated due to fluctuations in the flow rate.



ecology and environment, inc. International Specialists in the Environment Portland, Oregon.	McCORMICK AND BAXTER CREOSOTING CO. Portland, Oregon	FIGURE 2-2 TOTAL NAPL EXTRACTED DECEMBER 1995 THROUGH SEPTEMBER 1997			
		Drawn: MW	Date 2/27/98	Job No. OH4270	Dwg.No. [illegible]70F17

modifications to the system will be identified and may be completed during the next few months. No NAPL extraction problems were identified this quarter.

Section 5.2 describes a break-in at the FWDA treatment system. System measurements and NAPL measurement records were stolen from the FWDA container. Original field sheets and two weeks of NAPL measurements for October were lost as a result of the break-in.

2.3 DNAPL Up-Welling Test Results

During this quarter, pneumatic pumps installed in wells EW-9s, MW-Gs, and MW-Ds were operated to test the potential effects of DNAPL up-welling resulting from groundwater extraction above the DNAPL interface. The extraction of groundwater above the DNAPL could potentially increase DNAPL in the well.

The FWDA system was installed and started operation in July 1997. The system operated sporatically in August and September. Between October 1997 and December 1997, the pumps were operated on a continuous basis, which facilitated consistent collection of DNAPL measurements. The results of the measurements are graphically presented in Figures 2-3 through 2-5. For comparison purposes, DNAPL measurements for all of 1997 have been included on the figures.

2.3.1 EW-9s

Based on the DNAPL measurements, the DNAPL thicknesses in EW-9s decreased noticably after July 1997. During August and September, DNAPL thicknesses were measurable, though less than the pre-July 1997 levels. When consistent FWDA system operation was attained in October through December, the thickness of DNAPL was immeasurable. Based on this observation, extraction of groundwater from this well appears to have negatively influenced the quantity of DNAPL.

2.3.2 MW-Gs

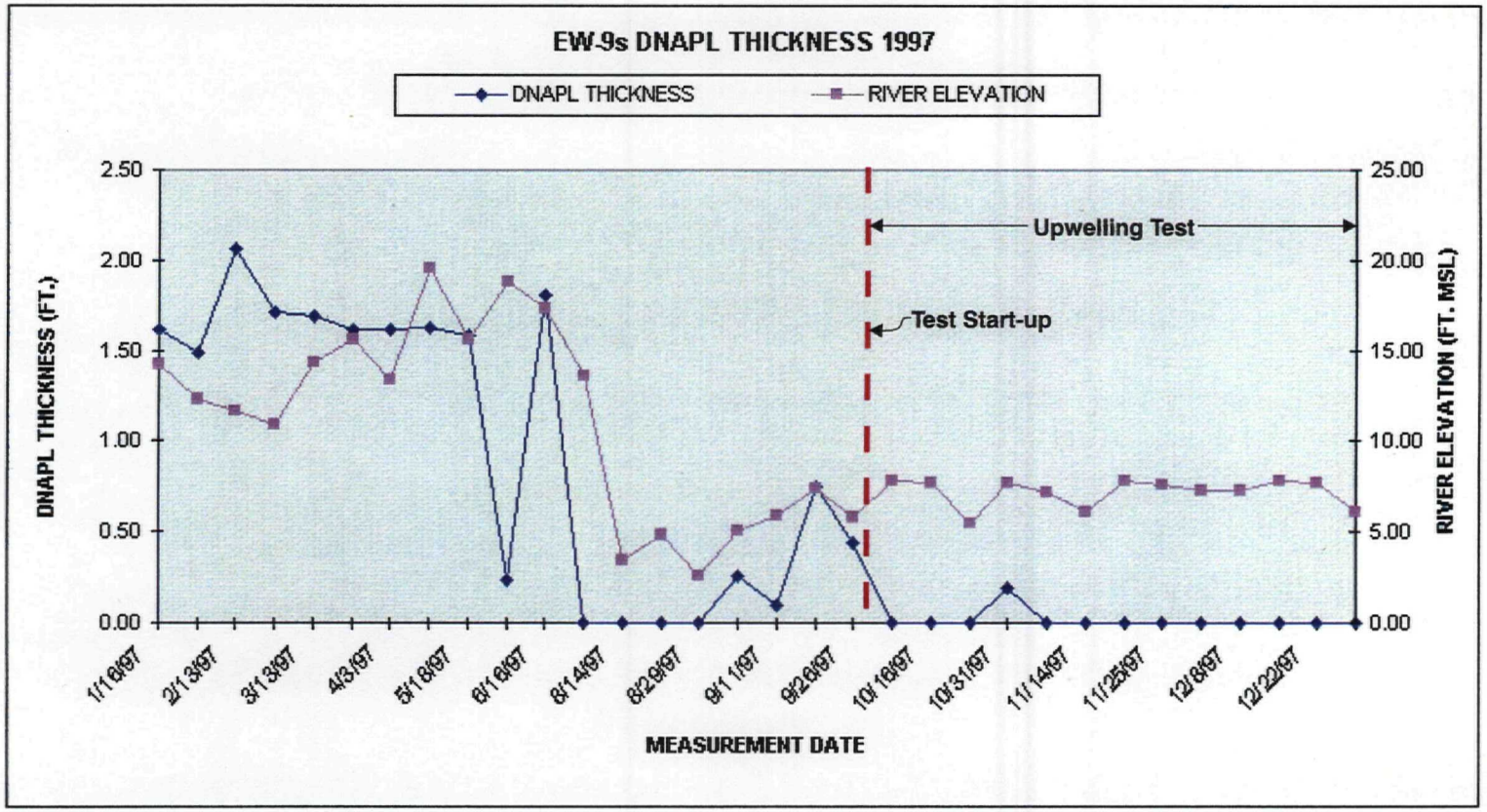
The DNAPL thickness data collected from MW-Gs during the up-welling test period appears to be inconclusive. The DNAPL measurements were not consistently at or above the range of DNAPL measurements typically observed in this well.

2.3.3 MW-Ds

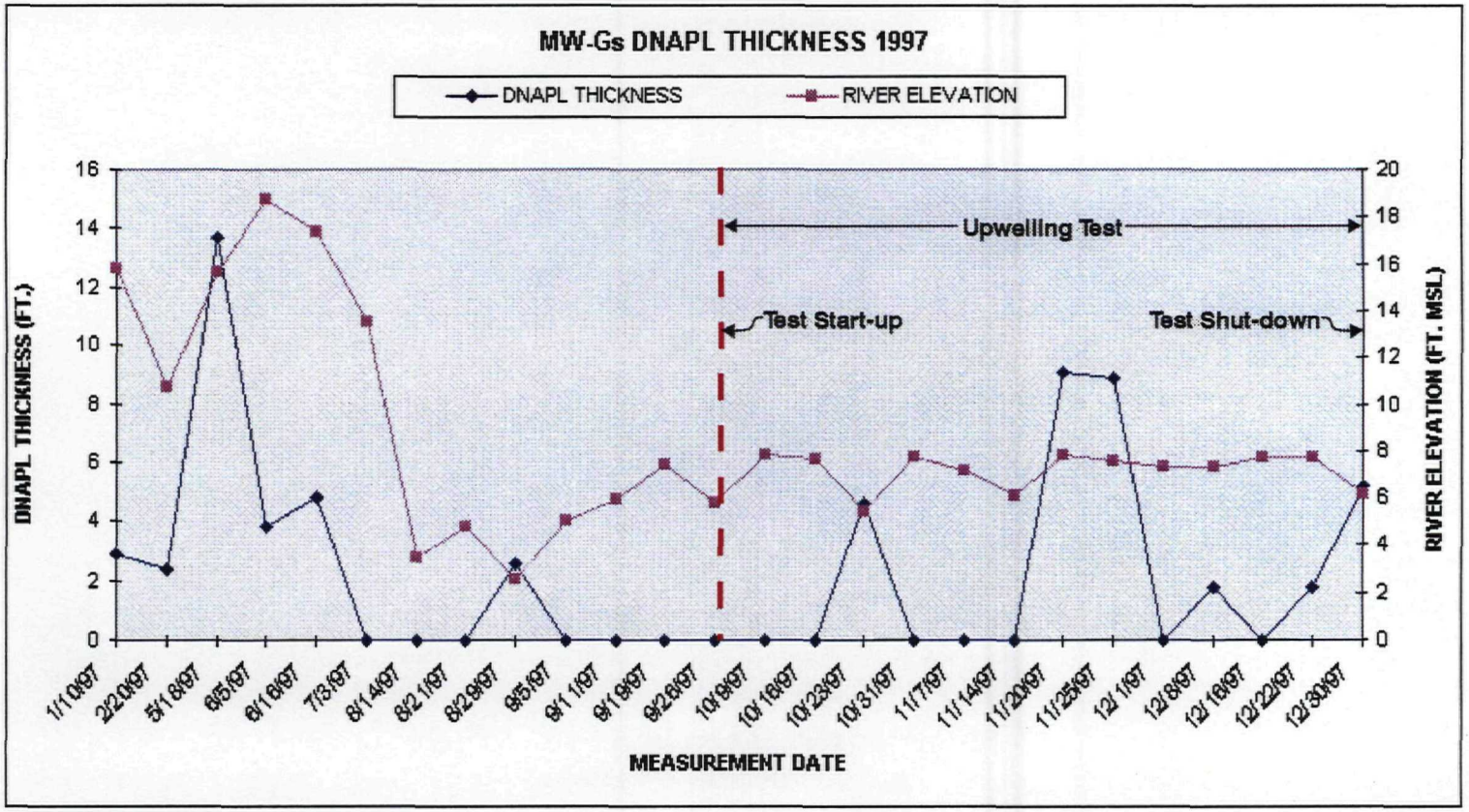
Mixed results for DNAPL up-welling were also noted at MW-Ds during the test period. The elevated DNAPL measurement (3.8 feet) recorded on October 23, 1997 was not the historic maximum, which was 6.01 feet recorded in January 1994. The reason for the lack of DNAPL between August and September is not known. The DNAPL measurements were not consisently at or above the range of DNAPL measurements typically observed in this well. It should be noted that in November 1997, LNAPL was detected in this well for the first time. Since this detection occurred during the up-welling test period, it may be possible to attribute the pumping activity with mobilization of LNAPL.

2.3.4 Up-Welling Summary

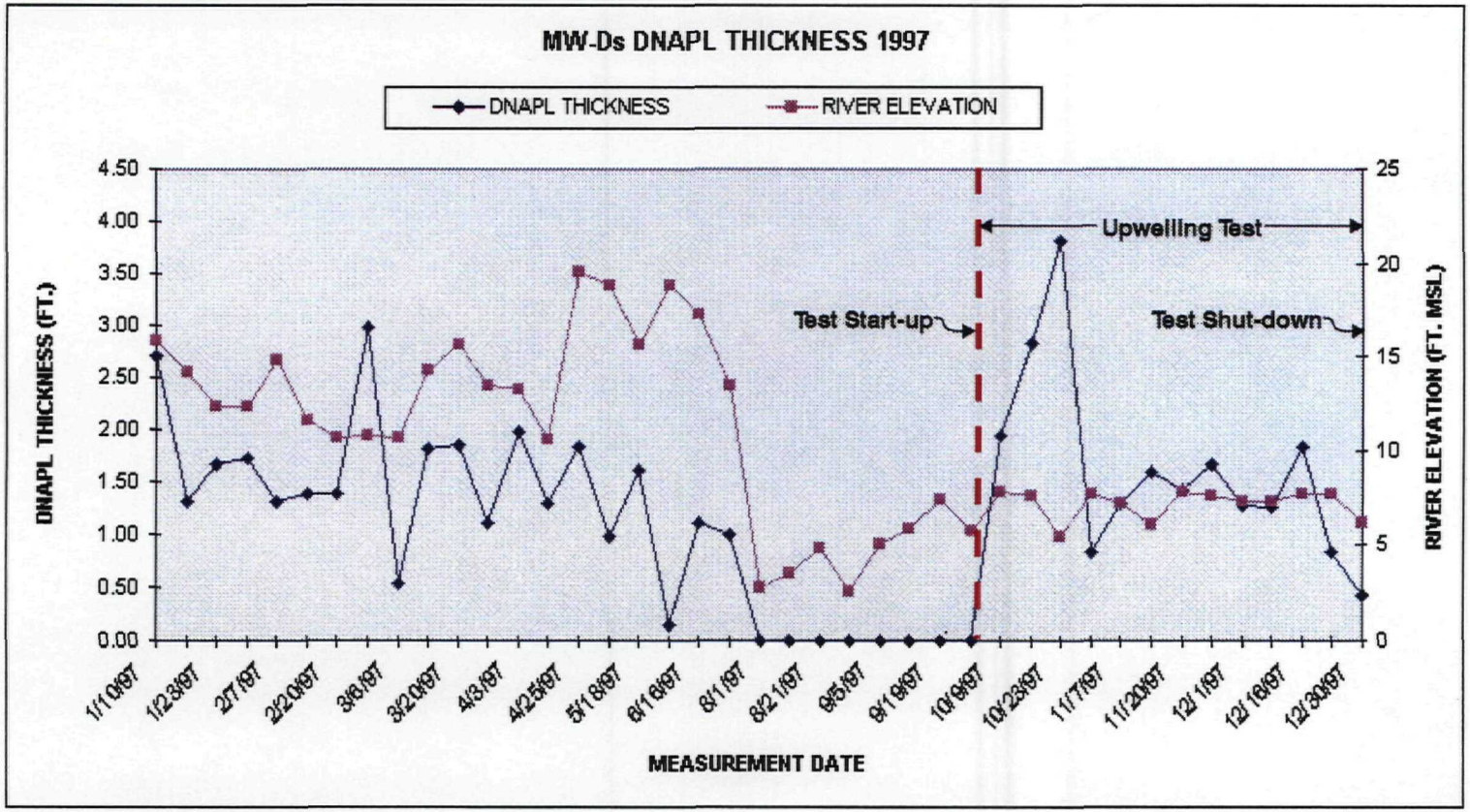
Based on the three month test period, data to support DNAPL up-welling appears to be inconclusive. However, one observation noted is that DNAPL thickness in EW-9s appears to be negatively influenced at the pumping rates utilized.



ecology and environment, inc. International Specialists in the Environment Portland, Oregon	McCORMICK AND BAXTER CREOSOTING CO. Portland, Oregon	FIGURE 2-3 EW-9s DNAPL THICKNESS 1997			
		Drawn: MW	Date 5/12/98	Job No. OH4270	Dwg.No. OH4270F12



ecology and environment, inc. International Specialists in the Environment Portland, Oregon	McCORMICK AND BAXTER CREOSOTING CO. Portland, Oregon	FIGURE 2-4 MW-Gs DNAPL THICKNESS 1997			
		Drawn: MW	Date 5/12/98	Job No. OH4270	Dwg.No. OH4270F10



ecology and environment, inc. International Specialists in the Environment Portland, Oregon	McCORMICK AND BAXTER CREOSOTING CO. Portland, Oregon	FIGURE 2-5 MW-Ds DNAPL THICKNESS 1997			
		Drawn: MW	Date 5/12/98	Job No. OH4270	Dwg.No. OH4270F11

3 Water Treatment Systems

3.1 Water Treatment Plant Operation Summary

The following sections present a summary of treatment system operations from October 1, 1997 through December 31, 1997.

3.1.1 Pilot Treatment System Operation Summary

The pilot treatment system experienced two brief operational difficulties during the fourth quarter 1997. On December 15, 1997, inspection by ADT's site technician revealed a heater malfunction for the caustic soda container, resulting in a frozen feed line. The system was temporarily shut down until December 17, 1997, when a new heater was installed. On December 29, 1997, the system was temporarily shut down due to a rupture in the casting in the bladder valve to the DAF unit. A new valve was purchased and scheduled to be installed on January 2, 1998.

During operation, an estimated 231,846 gallons of water/NAPL were extracted from the TFA extraction wells and conveyed to the water treatment system during this period. This volume is considered an estimate due to the limited accuracy of the flow measurements collected at each well.

The dissolved air flotation (DAF) unit operated for a total of 424 hours, and a total of 221,540 gallons of water were treated. The DAF unit generated approximately 10,836 gallons of sludge, which was stored in the sludge tank. The DAF unit consumed approximately seven 55-gallon drums of RO-40 (heavy metal precipitator and coagulant), eight 5-gallon buckets of RO-2200 flocculent, and one 700-pound drum of caustic soda. Utilization of a concentrated form of RO-2200 was continued to allow the system operator to have better control over the quality of the polymer mixture.

The granular activated carbon (GAC) component of the treatment system was operated for 389 hours. A total of 226,670 gallons of water were filtered through the GAC. Two GAC vessels were consumed.

The discrepancy between the volume of water extracted from the TFA extraction wells (231,846 gallons) and the volume treated through the DAF and GAC units (221,540 gallons and 226,670 gallons, respectively) is a result of the storage of water in the treatment system tanks

and, to a lesser extent, the limited accuracy of the water volume measurement techniques and meters. The difference between the volumes of water in the TFA wells and the DAF can be attributed to water remaining in the TFA holding tank and tank 1. The difference between the volumes of water in the DAF and GAC can be attributed to water remaining in the DAF and tank 2.

Weekly effluent samples were collected from the system to evaluate the treatment's effectiveness and compliance with site discharge limits. The analytical results for these samples are presented in Section 3.1.3.

3.1.2 FWDA Treatment System Operation Summary

Trouble-free operation of the FWDA treatment system was maintained for the duration of the quarter. During operation, 29,068 gallons of water were treated and discharged from the FWDA treatment system. Approximately 0.3 feet of DNAPL was detected in the settling tank or oil/water separator, amounting to a volume of approximately 53 gallons. LNAPL was visually present within the oil/water separator, and the LNAPL was properly retained by the separator. Approximately 0.03 feet of LNAPL totaling approximately 0.6 gallons was detected in the LNAPL storage drum. The effluent from the separator's holding chamber was visibly clear in comparison to the dark brown water entering the separator. Weekly effluent samples were collected from the system to evaluate the treatment's effectiveness and compliance with the site discharge limits. The analytical results for these samples are presented in the following section.

3.1.3 Effluent Discharge Monitoring Results

The effluent analytical data collected during this quarter are presented in Table 3-1. Eight (8) effluent samples exceeded the allowable National Pollutant Discharge Elimination System (NPDES) maximum daily discharge concentrations for total zinc, resulting in NPDES monthly average total zinc exceedances for October and December 1997.

Pilot Water Treatment System

Based on effluent discharge analytical results, the pilot water treatment system operated in compliance for the entire fourth quarter 1997. Effluent samples DD48-DD55 were collected from the pilot water treatment system and analyzed for polycyclic aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), total arsenic, total chromium, total copper, and total zinc. No exceedances above NPDES allowable levels or significantly elevated contaminant concentrations were detected.

FWDA Treatment System

Effluent samples FWDA4-FWDA12 were collected from the FWDA treatment system and analyzed for PAHs, PCP, total arsenic, total chromium, total copper, and total zinc. Eight (8) samples (FWDA4-FWDA7, FWDA9-FWDA12) exceeded the allowable NPDES maximum daily discharge concentration for total zinc (190 μg/L). The exceedances ranged from 317 to 11,200 μg/L, with the maximum occurring on the October 21, 1997 sample date.

3.1.4 Operation Modifications

No operation modifications were performed during this quarter.

3.1.5 Problems and Corrective Actions

To reduce the metals concentrations (e.g. total zinc) discharging from the FWDA system to below NPDES allowable levels, an ion exchange unit was ordered during the fourth quarter, 1997. The system was purchased from Aero-Terra-Aqua (ATA) Technologies Corp., located in Cleveland, Ohio. The system consists of approximately three cubic feet of AF201 cation sorbent contained in a flow-thru vessel. E & E anticipates installation of the ion exchange unit during early first quarter 1998. The system's removal results will be discussed during the first quarter 1998 report.

Aside from the pilot treatment system operation problems noted in Section 3.1.1, no other problems were identified during this quarter.

3.1.6 Off-Site Disposal

No off-site disposal was conducted during this quarter.

Table 3-1

SUMMARY OF EFFLUENT DISCHARGE RESULTS
OCTOBER 1, 1997 TO DECEMBER 31, 1997
MCCORMICK & BAXTER CREOSOTING COMPANY

PORTLAND, OREGON

Effluent Sample Date	Sample Number	Total Gallons	Discharge Dates	Discharge Rate (Gallons/day)	pH	Total PAHs (µg/L)	PCP (µg/L)	Total Arsenic (µg/L)	Total Chromium (µg/L)	Total Copper (µg/L)	Total Zinc (µg/L)
NPDES Monthly Average	**NA**	**NA**	**NA**	**NA**	**6.5 - 8.5**	**1700**	**22**	**80**	**350**	**20**	**190**
NPDES Daily Maximum	**NA**	**NA**	**NA**	**43,200**	**6.5 - 8.5**	**2500**	**33**	**120**	**500**	**30**	**280**
10/6/97	DD48	23,587	9/29/97	3,370	6.9	ND	0.74 U	2.1	0.58 U	16.8 U	17.2 U
10/6/97	FWDA4	7,330	8/30/97	198	6.9	ND	0.74 U	4.5	0.58 U	16.8 U	954
10/13/97	DD49	21,909	10/7/97	3,652	7.1	1.15	0.74 U	3.2	0.58 U	16.8 U	6.9 U
10/13/97	FWDA5	1,895	10/7/97	316	6.9	ND	0.74 U	6.8	0.58 U	16.8 U	530
10/21/97	DD50	23,468	10/14/97	3,353	6.8	ND	0.67 U	2.5	0.58 U	16.8 U	13.8 B
10/21/97	FWDA6	2,096	10/14/97	299	6.9	ND	0.67 U	1.5	1.6 B	16.8 U	11200
OCTOBER 1997 AVERAGE					**6.9**	**1.15**	**<0.72**	**3.4**	**0.75**	**16.8 U**	**2120**
11/3/97	DD51	35,513	10/22/97	2,959	6.7	ND	0.74 U	1.6	0.58 U	16.8 U	23.5
11/3/97	FWDA7	1,790	10/22/97	149	6.9	ND	0.74 U	7.1	0.58 U	16.8 U	468
11/13/97	DD52	34,243	11/4/97	3,805	6.9	ND	0.49 U	2.4	0.99 B	16.8 U	13.7 B
11/13/97	FWDA8	1,594	11/4/97	177	7.2	ND	0.45 U	81.7	397	16.8 U	8 B
11/21/97	DD53	20,720	11/17/97	5,180	6.8	ND	0.48 U	1.6	0.58 U	16.8 U	20.1
11/21/97	FWDA9	2,786	11/14/97	398	7.0	ND	0.45 U	11.0	0.89 B	16.8 U	541
NOVEMBER 1997 AVERAGE					**6.9**	**ND**	**<0.56**	**17.6**	**66.8**	**16.8 U**	**179.1**
12/1/97	DD54	31,873	11/18/97	2,452	6.8	ND	0.57 U	1.1	0.58 U	16.8 U	6.9 U
12/1/97	FWDA10	1,910	11/22/97	212	7.1	ND	0.57 U	10.4	0.58 U	16.8 U	551
12/9/97	DD55	27,102	12/2/97	3,872	6.9	ND	0.55 U	0.91	0.58 U	16.8 U	20
12/9/97	FWDA11	5,575	12/2/97	796	7.1	0.34	0.46 U	6.2	0.58 U	16.8 U	317
12/17/97	FWDA12	4,092	12/10/97	585	7.1	ND	0.5 U	8.8 B	0.58 U	16.8 U	415
DECEMBER 1997 AVERAGE					**7.0**	**0.34**	**<0.53**	**5.5**	**0.58 U**	**16.8 U**	**262**

Key:

U - Compound was analyzed for but not detected; the corresponding value is the detection limit.

B - Inorganic compound was analyzed for and positivilely identified, but the associated numerical value is an estimated quantity (above the method detection limit, MDL, but below the practical quantitation limit, PQL).

J - Organic compound was analyzed for and positivilely identified, but the associated numerical value is a estimated quantity (above the method detection limit, MDL, but below the practical quantitation limit, PQL).

ND - None dectected

NA - Not applicable

NM - Not measured

- Concentrations exceed discharge permit

NOTE: Monthly average concentrations that contain "U" data are calculated using the corresponding detection limit value.

4 Quarterly Groundwater Monitoring

Monitoring wells were sampled by E & E for the third quarterly groundwater sampling event during the week of October 27, 1997. The objective of quarterly groundwater sampling is to delineate areas where dissolved-phase organic and inorganic site contaminants are present in groundwater.

4.1 Groundwater Elevation Measurements

Groundwater elevations were measured in approximately 20 wells located throughout the site to determine the direction of groundwater flow. Daily groundwater fluctuations of several feet are common in the monitoring wells and are due primarily to river stage elevation changes, tidal influences, precipitation, and barometric pressure. In addition, pressure transducer data (elevation and temperature) for wells EW-19s, EW-3s, MW-34i, MW-16s, and MW-11s were collected during the third quarter and are included in Appendix A.

Horizontal Gradient

Horizontal groundwater gradients for the site were determined for average groundwater flows during the quarter.

The average shallow horizontal groundwater gradient determined from measurements made on October 27, 1997, indicated a gradient in the TFA of approximately 0.004 (21.12 feet/ mile) toward the river and a gradient in the FWDA of approximately 0.007 (36.96 feet/mile) toward the river. The gradients were determined between wells EW-12s and MW-16s in the TFA and MW-14s and MW-Fs in the FWDA.

The average intermediate horizontal groundwater gradients were not determined in the TFA or the FWDA, as it is expected that gradients and directions are similar to the shallow aquifer zone. The intermediate aquifer zone is in direct contact with the shallow aquifer zone near the river.

No horizontal gradients were determined for the deeper aquifers at the site due to the limited number of wells screened within the deep aquifer.

Vertical Gradients

A comparison of paired monitoring wells MW-Is, MW-Ni, and MW-23d was performed to identify vertical groundwater gradients at the site, specifically the TFA. A vertical groundwater gradient of 0.065 downward was determined between the shallow and intermediate well for October 31, 1997. A gradient of 0.012 downward was determined in the intermediate and deep well on October 31, 1997.

4.2 River Elevation Measurements

The Willamette River pressure transducer recorded elevation and temperature data during each day of the 1997 fourth quarter on an hourly basis. The transducer data is presented in Appendix A.

4.3 Quarterly Sampling Activities

Samples were collected from wells installed during the remedial investigation to evaluate the extent of groundwater contamination in the shallow, intermediate, and deep groundwater zones at the site (see Table 4-1). Groundwater samples were submitted to DEQ's laboratory in Portland, Oregon for analysis of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total metals, and total recoverable petroleum hydrocarbon (TRPH). Dissolved metals were eliminated from the sampling activities. Low flow sampling techniques have shown that the total and dissolved metals concentrations from samples collected at the site were within acceptable ranges of one another.

Groundwater samples were extracted from eighteen (18) wells using dedicated submersible pumps (Grundfos Redi-Flow 2 and 12-volt K-V), dedicated tubing installed within each well, and low-flow sampling techniques. Samples for all analytical parameters were collected directly into sample containers from the pump. Purge water was containerized in DOT 17E/17H 55-gallon drums and treated in the on-site treatment system. After samples were placed in appropriate containers, they were preserved as required, placed on ice, and stored in coolers prior to delivery to the DEQ laboratory. A detailed description of sampling protocol is provided in E & E's Pre-Remedial Design Work Plan dated February 1996. Note, wells MW-15s and MW-16s, which are generally sampled, were not sampled this quarter. The water column in MW-15s was too shallow to pump, and the dedicated pump in MW-16s was inoperable.

4.4 Groundwater Quality

Table 4-1 presents the organic and inorganic detections for the quarterly sampling event. A brief discussion of dissolved organic and inorganic contaminants in groundwater is presented below. In general, the wells selected for quarterly sampling were wells located along the site

Table 4-1

4th QUARTER 1997
QUARTERLY SAMPLING ANALYTICAL RESULTS
MCCORMICK & BAXTER CREOSOTING COMPANY, PORTLAND, OREGON
SAMPLE COLLECTION DATE: October 1997
UNITS: mg/L
NOTE: Analytical results are presented for detections only.

Chemical Name (1)	EW-12s	MW-Ni	EW-19s	MW-13i	MW-14s	MW-17s	MW-17s-Dup	MW-18s	MW-23d	MW-29s
Arsenic			0.0109	0.0241		0.0399	0.0399	0.0206	0.0032	0.187
Copper					0.0003				0.00036	
Chromium	0.00094	0.00116	0.00355	0.0094	0.00082	0.00069	0.00069	0.00647	0.00042	0.00063
Zinc	0.00422	5.92	0.00707	0.0136	0.00576	0.0226	0.0226	0.00681	0.00312	0.00816
TRPH (estimate of %NAPL)	5.5	0.6	8.3			1.1	1.0	14.4		12
Pentachlorophenol	0.68	0.054	10.3			2.54	2.33	1.4		0.033
Total PAHs	3.388	0.0019	9.068			0.0014	0.0011	15.004	0.0007	13.485

(1) Analytical results are reported for Alternate Concentration Limit (ACL) compounds only. These compounds are specified in the ROD.

= Concentration exceeds the ACL.

ACL Concentrations

Total PAHs	43 mg/l
Pentachlorophenol	5 mg/l
Arsenic	1 mg/l
Chromium	1 mg/l
Copper	1 mg/l
Zinc	1 mg/l

Duplicates

MW-17s/MW-17s-Dup
MW-Fs/MW-Fs-Dup

Table 4-1

4th QUARTER 1997
QUARTERLY SAMPLING ANALYTICAL RESULTS
MCCORMICK & BAXTER CREOSOTING COMPANY, PORTLAND, OREGON
SAMPLE COLLECTION DATE: October 1997
UNITS: mg/L
NOTE: Analytical results are presented for detections only.

Chemical Name (1)	MW-2s	MW-3s	MW-4s	MW-5s	MW-As	MW-Ks	MW-LRs	MW-Fs	MW-Fs-Dup	MW-Os
Arsenic			0.0093	0.0043			0.0117	0.0319	0.0331	0.0043
Copper	0.00217									
Chromium	0.00124	0.00103	0.00089	0.00078	0.00103	0.00326	0.00108	0.00192	0.00211	0.00078
Zinc	0.0113	0.00972	0.0105	0.745	0.00972	0.326	0.00306	0.0113	0.0112	0.745
TRPH (estimate of %NAPL)							9.8	9.0	11.5	
Pentachlorophenol						0.007	1.4	0.67	0.67	
Total PAHs			0.0063	0.0165		0.0166	18.025	16.469	18.097	

(1) Analytical results are reported for Alternate Concentration Limit (ACL) compounds only. These compounds are specified in the ROD.

= Concentration exceeds the ACLs.

ACL Concentrations	
Total PAHs	43 mg/l
Pentachlorophenol	5 mg/l
Arsenic	1 mg/l
Chromium	1 mg/l
Copper	1 mg/l
Zinc	1 mg/l

Duplicates
MW-17s/MW-17s-Dup
MW-Fs/MW-Fs-Dup

boundaries and the river and not directly within the free-product NAPL plumes in the TFA and FWDA. During past quarterly sampling events, several wells were identified that contained significant amounts of NAPL, which causes artificially higher dissolved groundwater concentrations in the samples. The concentrations of contaminants would obviously be expected to be higher in wells in which pure-phase NAPL is present, and previously collected analytical data show this to be the case at the site.

Arsenic

Total arsenic was detected in 11 of the 18 quarterly monitoring wells. The concentrations ranged from 0.0032 mg/L to 0.187 mg/L. None of the arsenic detections exceeded the alternate concentration limit (ACL) for arsenic of 1 mg/L defined in the Record of Decision (ROD). The frequency and range of arsenic concentrations detected in this quarter are generally consistent with the data from the previous quarters.

Chromium

Total chromium was detected in all 18 quarterly monitoring wells. The concentrations ranged from 0.00042 mg/L to 0.0094 mg/L. None of the chromium detections exceeded the ACL for chromium of 1 mg/L defined in the ROD. The frequency of chromium concentrations detected this quarter is slightly higher than the previous quarter; however, the concentration range is slightly lower.

Copper

Total copper was detected in 3 of the 18 quarterly monitoring wells. The concentrations ranged from 0.0003 mg/L to 0.0094 mg/L. None of the copper detections exceeded the ACL for copper of 1 mg/L defined in the ROD. The frequency of copper concentrations detected in this quarter is consistent with previous quarters. The range, however, is approximately one order of magnitude lower.

Zinc

Total zinc was detected in all 18 quarterly monitoring wells. The concentrations ranged from 0.00306 mg/L to 5.92 mg/L. The ACL for zinc defined in the ROD is 1 mg/L. One detection exceeded the ACL: MW-Ni at 5.92 mg/L. Monitoring wells MW-Ks and MW-Os, which typically contained elevated concentrations of zinc, were not elevated this quarter. The detection of MW-Ni is consistent with the previous quarter.

Total Recoverable Petroleum Hydrocarbons

TRPH analysis is conducted as a method for determining the percent of NAPL in the water samples. Elevated concentrations of TRPH (i.e., the presence of NAPL in the water) could impact the analytical results of the dissolved organic contaminants. TRPH was detected in 8 of the 18 quarterly monitoring wells. The concentrations ranged from 0.6 mg/L to 14.4 mg/L. There is no ACL for TRPH defined in the ROD. The frequency and range of TRPH concentrations detected this quarter are generally consistent with the data from the previous quarters.

Pentachlorophenol

PCP was detected in 9 of the 18 quarterly monitoring wells. The concentrations ranged from 0.007 mg/L to 10.3 mg/L. The ACL for PCP defined in the ROD is 5 mg/L. One detection exceeded the ACL: EW-19s at 10.3 mg/L. This exceedance is not consistent with previous quarters which generally reported EW-19s concentrations orders of magnitude less and below the ACL. EW-19s, along with MW-LRs and MW-29s, is also considered a compliance point; therefore, EW-19s did not meet ACL's for this quarter. Monitoring wells MW-LRs and MW-29s, however, are in compliance. PCP was detected in MW-LRs at 1.4 mg/L and in MW-29s at 0.033 mg/L, both of which are below the ACL.

Total Polycyclic Aromatic Hydrocarbons

Concentrations for PAHs were determined by summing concentrations for all detected PAH compounds. Total PAHs were detected in 12 of the 18 quarterly monitoring wells. The concentrations ranged from 0.0007 mg/L to 18.097 mg/L. The ACL for total PAHs defined in the ROD is 43 mg/L. No detections of total PAHs exceeded the ACL. Monitoring wells MW-LRs, EW-19s, and MW-29s, located near the river, are considered compliance points. PAHs were detected in MW-LRs at a total concentration of 18.025 mg/L, EW-19s at a total concentration of 9.068 mg/L, and MW-29s at a total concentration of 13.485 mg/L, all lower than the ACL. The concentrations, however, are generally higher detected in previous quarters.

Monitoring Well MW-23d

Monitoring well MW-23d is screened in the deep aquifer and is located in the TFA. Arsenic, chromium, and zinc have been detected in this well since the second quarter of 1997. Historically, arsenic and zinc have been detected in all of the quarterly sampling events for the past year. Chromium was detected during this fourth quarter event for the first time. The detection of arsenic and possibly zinc may be a result of elevated background concentrations for

these metals. The chromium detection during this quarter may be the result of cross-contamination during sampling. Monitoring well MW-23d will continue to be tracked for trends or outliers during future sampling events.

4.5 Site Database

All data previously generated by PTI during the remedial investigation/feasibility study process and data currently generated by E & E during operation of the site have been incorporated into an electronic database using Microsoft Access™. The query structure for normal database operation is under development and has been expanded based on data needs for the operation of the site (e.g., determination of well screen elevations versus groundwater elevations versus LNAPL thickness). Information is imported into Access from electronic files when available, or entered manually if not available in a compatible electronic format.

All sample numbers and analytical data for the site have been incorporated into the database, including as-built information for all existing monitoring and extraction wells. Spatial (northing/easting coordinates) and elevation/depth information for each sample location have also been incorporated into the database.

Analytical data collected by E & E are incorporated into the database as the data are received from the laboratory, and data collected from the monitoring wells and daily site activities are entered into the database on a weekly or monthly basis. Currently, quarterly sampling data from DEQ is not provided to E & E in an electronic format; consequently, E & E is required to manually enter the data into the database.

The database is capable of providing tabulated and formatted data via querying procedures for contouring, statistical programs, or other software. The data can then be used in the calculation of volume estimates for potential removal alternatives or interim removal action measures, or any other use, as necessary.

The database is in a compatible format and can be provided to DEQ for use in their own database system. The database is available for inspection and is currently maintained in E & E's offices in Seattle and Portland.

5 General Site Operations

5.1 Health and Safety

No accidents or injuries occurred during this quarter.

5.2 Site Security

On November 7, 1997, the container that houses the FWDA treatment system was vandalized. Miscellaneous tools, papers, and some filters were stolen. Two bag filters were later recovered nearby. The break-in was reported to the police. No significant damage to equipment resulted; however, two weeks of system measurements and NAPL measurements were stolen.

6 Conclusions and Recommendations

6.1 Maximum NAPL Thicknesses

In Section 2.1, four wells were identified that contained maximum LNAPL measurements during this quarter: EW-12s, EW-17s, MW-Ds, and MW-20i. EW-12s is located near Retorts 1 and 2; EW-17s is located between the Tank Farm and Creosote Tank; and MW-20i and MW-Ds are located between the FWDA and the river, and both have bladder pumps installed as part of the continuous NAPL extraction system. The pump in MW-Ds is installed in the water column as part of the DNAPL up-welling tests discussed in Section 6.4. The pump in MW-20i is installed at the bottom of the well to perform continuous DNAPL extraction. All maximum LNAPL measurements were recorded in November 1997. During this month, the groundwater and river level measurement recorded with pressure transducers were relatively fixed (i.e. no large fluctuations of 5 feet or more). The reason(s) for the increase in LNAPL is not known.

6.2 Changes in NAPL Well Classifications

Based on the NAPL classifications presented in Section 2, NAPL appeared to be migrating during this quarter. In the TFA, there was a loss of DNAPL from wells located between the Tank Farm and the Interceptor Trench area. The cause for this change is not known. No surrounding wells contained an increase in DNAPL. In the FWDA, eleven wells had classification changes. Of the eleven wells, a decrease in either LNAPL or DNAPL was observed in seven wells, and an increase was observed in the remaining four. One potential reason for the observed decrease is the continous NAPL extraction being performed in four FWDA wells. No obvious NAPL migration patterns, however, could be concluded.

6.3 LNAPL Skimmers

Based on the operation of two passive LNAPL skimmers installed at MW-1s and EW-15s, E & E recommends the purchase and installation of six additional passive LNAPL skimmers. E & E proposes to install the new skimmers in EW-10s, MW-21s, EW-17s, MW-Rs, EW-18s, and MW-10s. These wells presently and/or historically have contained significant,

extractable quantities of LNAPL (see Table 2-1). In addition, E & E proposes to empty the skimmers on a weekly basis, rather than bi-weekly.

6.4 Up-Welling Recommendations

E & E recommends modifying the pump location and rate in EW-9s. E & E proposes to place the pump intake above the NAPL/water interface for groundwater extraction only. E & E would operate this well at an increased flow rate for two to three additional months and will continue to monitor for any up-welling effect.

At MW-Gs and MW-Ds, E & E recommends placing the pump intakes at the bottom of the wells to increase DNAPL extraction in the FWDA..

6.5 FWDA NAPL Extraction Expansion

E & E recommeds expansion of the continuous FWDA NAPL extraction activities in order to increase the quantity of NAPL removed from the aquifer. Based on DNAPL thickness measurement data (see Table 2-2), connection of EW-6s and EW-Es to the FWDA extraction and treatment system should be forthcoming.

DNAPL thickness measurements in MW-20i have consistently remained elevated during DNAPL extraction periods. As such, E & E recommends increasing the extraction rate at this well.

6.6 NPDES Exceedances

Exceedances of site discharge limits for zinc were detected in effluent samples taken from the FWDA Treatment System during the fourth quarter 1997. At the time of preparing this report, E & E has completed the installation of an ion exchange unit for the FWDA system. Following installation of the exchange unit, effluent samples have yet to contain metals concentrations above the method detection limits. The results will be summarized in the next quarterly report.

Appendix A
Transducer Data